

SECARB CO2 Sequestration in Coal Seams: Central Appalachian Basin

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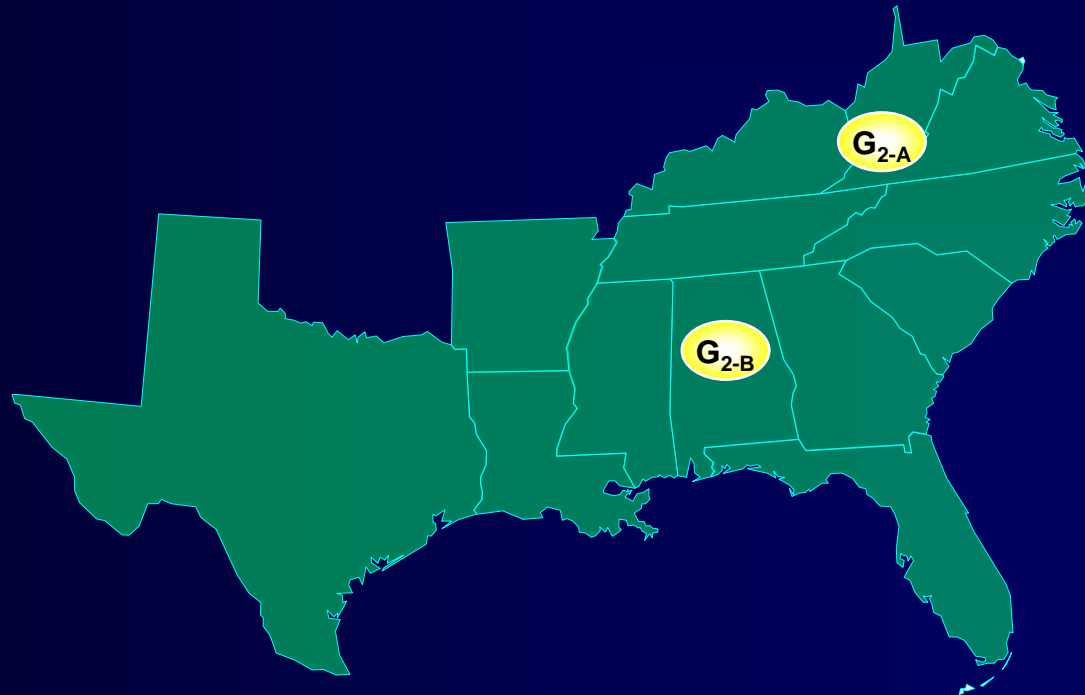
SECARB Coal Group Phase II

CO₂ ECBM recovery:

- Unmineable coals can provide sequestration and add economic value
- At least 1,000 MMT CO₂ of feasible capacity in the targeted areas

Two target areas:

- Central Appalachian Basin, G_{2-A}
- Black Warrior Basin, G_{2-B}
- 1,000 tons of CO₂ injected on each site



SECARB Coal Group Research Team

- ❖ Southern States Energy Board
- ❖ Virginia Center for Coal and Energy Research – Virginia Tech
- ❖ Marshall Miller and Associates, Inc.
- ❖ Geological Survey of Alabama
- ❖ University of Alabama
- ❖ Southern Company
- ❖ Kentucky Geological Survey
- ❖ Advanced Resources International
- ❖ Eastern Coal Council

SECARB Coal Group - Phase II Partners

(Cost Share, Data, Wells)

- ❖ Alawest
- ❖ Alpha Natural Resources
- ❖ AMVEST
- ❖ Buckhorn Coal
- ❖ CCP2 Project
- ❖ CDX Gas
- ❖ CNX Gas
- ❖ CONSOL Energy
- ❖ Cumberland Resources
- ❖ Dart Oil & Gas
- ❖ Denbury Resources
- ❖ Dominion E&P
- ❖ Dominion Resources
- ❖ Eastman Chemical Company
- ❖ EPRI
- ❖ Equitable Production
- ❖ Clean Energy Technology Inst (MSU)
- ❖ GeoMet
- ❖ McJunkin Appalachian
- ❖ Norfolk Southern
- ❖ Natural Resource Partners
- ❖ Oak Ridge National Laboratory
- ❖ Penn Virginia
- ❖ Pine Mountain Oil & Gas
- ❖ Piney Land
- ❖ Pocahontas Land
- ❖ RMB Earth Science Consultants
- ❖ Univ. British Columbia

SECARB Coal Group

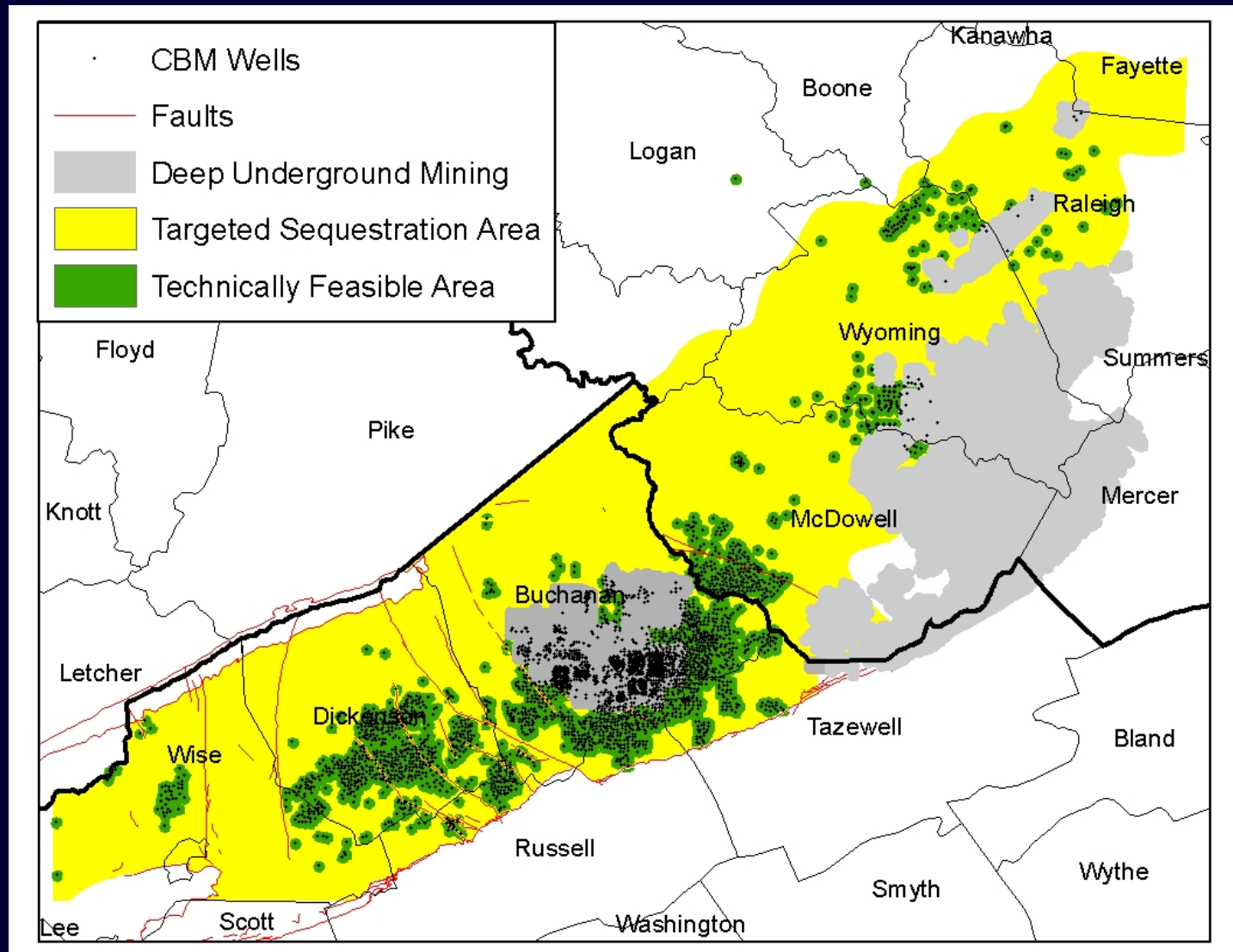
Phase II Project Tasks

- ❖ Regional Characterization and Site Selection
- ❖ Reservoir Modeling
- ❖ Core Hole Drilling and Evaluation
- ❖ Pilot Preparation and Risk Analysis
- ❖ Pilot Project Operations
- ❖ Interpretation and Assessment
- ❖ Public Outreach
- ❖ Technology Transfer

Central Appalachian Field Test – Progress Overview

- ❖ Finalized Sequestration and ECBM Assessment for Central Appalachian Basin
- ❖ Developed a suite of geologic maps for sequestration and ECBM analysis
- ❖ Selected a CNX Gas well for field test
- ❖ Finalized indemnification and operating agreements with CNX Gas and Buckhorn Coal Company
- ❖ Conducted required safety training from CNX Gas
- ❖ Working with EPA and Virginia Department of Mines, Minerals and Energy on permitting requirements
- ❖ Outreach activities:
 - Sequestration Session at the Eastern Coal Council Annual Meeting, May 21-22, 2007
 - Russell County Board of Supervisors, Participation in Public Meeting, November 5, 2007

Evaluated Sequestration Area



Sequestration Potential

Phase II Study Areas	
Storage capacity in all non-mining areas ¹	23.1 Tcf (1,341 MMt)
Storage only in developed CBM areas ²	6.86 Tcf (398 MMt)

¹ Assumes no carbon sequestration potential in Pocahontas No. 3, No. 4 and Beckley seam mining areas.

² Assumes sequestration feasibility is limited to established CBM development areas.

³ WV portion of study area has 8.88 Tcf total storage capacity and 1.49 Tcf feasible storage capacity.

Enhanced CBM Potential

Phase II Study Areas	
ECBM potential in all non-mining areas ¹	2.49 Tcf
ECBM only in developed CBM areas ²	0.79 Tcf

¹ Assumes no ECBM potential in Pocahontas No. 3, No. 4 and Beckley seam mining areas and horizontal CBM well development areas.

² Assumes ECBM feasibility is limited to established CBM development areas.

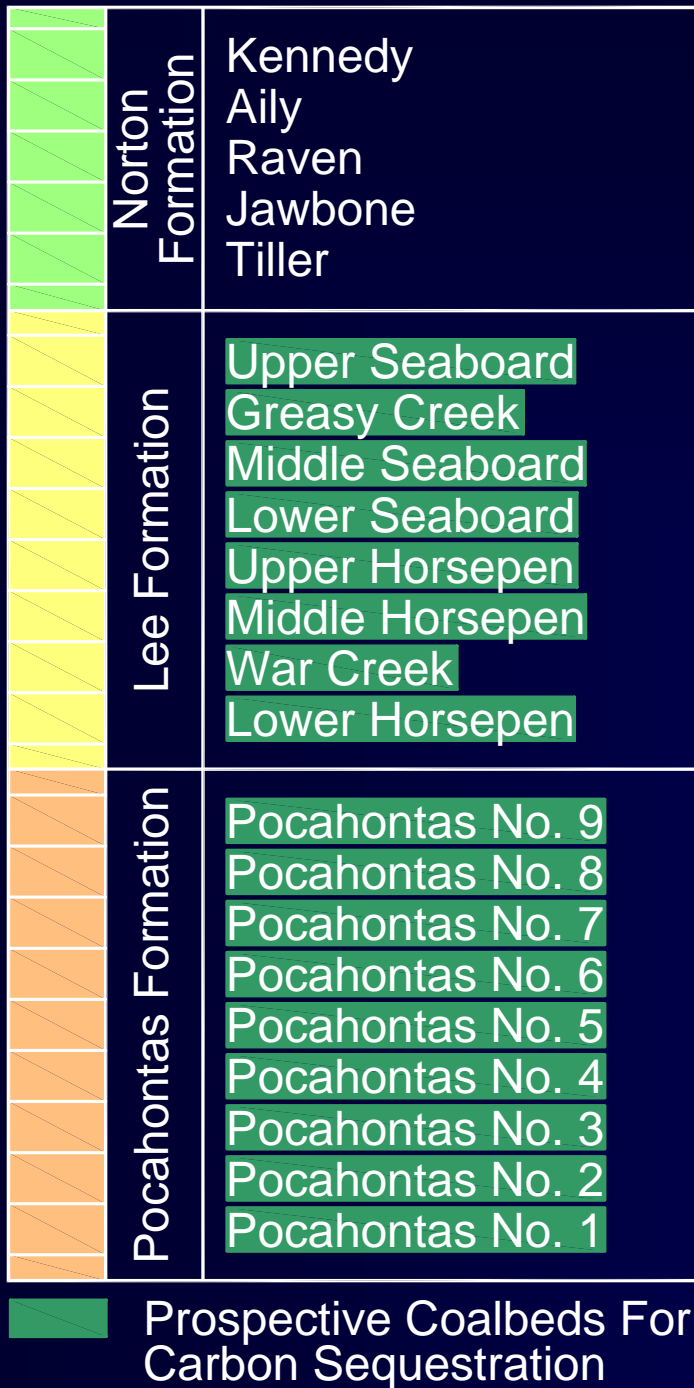
³ WV portion of study area has 0.80 Tcf total ECBM and 0.14 Tcf feasible ECBM.

Pilot-Site Monitoring and Testing

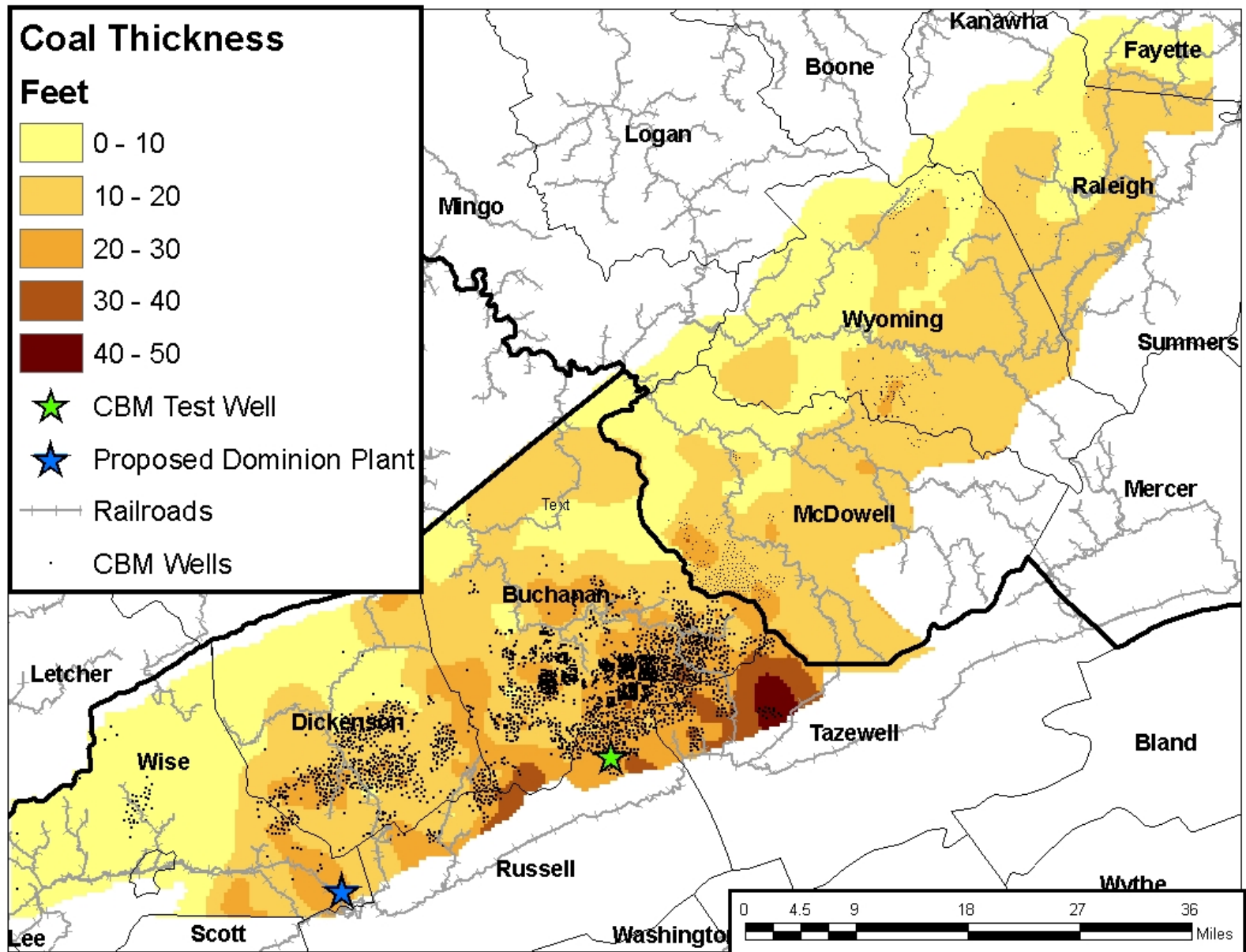


Central Appalachian Basin

Generalized Stratigraphic Column



CNX Gas Field Test Location



Topographic map showing the location of the CNX Gas Injection Well BD114. The map features contour lines, a river, and several mines. A blue star marks the location of the CNX Gas Injection Well BD114. Red dots indicate other wells or points of interest. The map includes labels for 'Strip Mine', 'Creek', and 'Hill'.



Pilot Injection Well

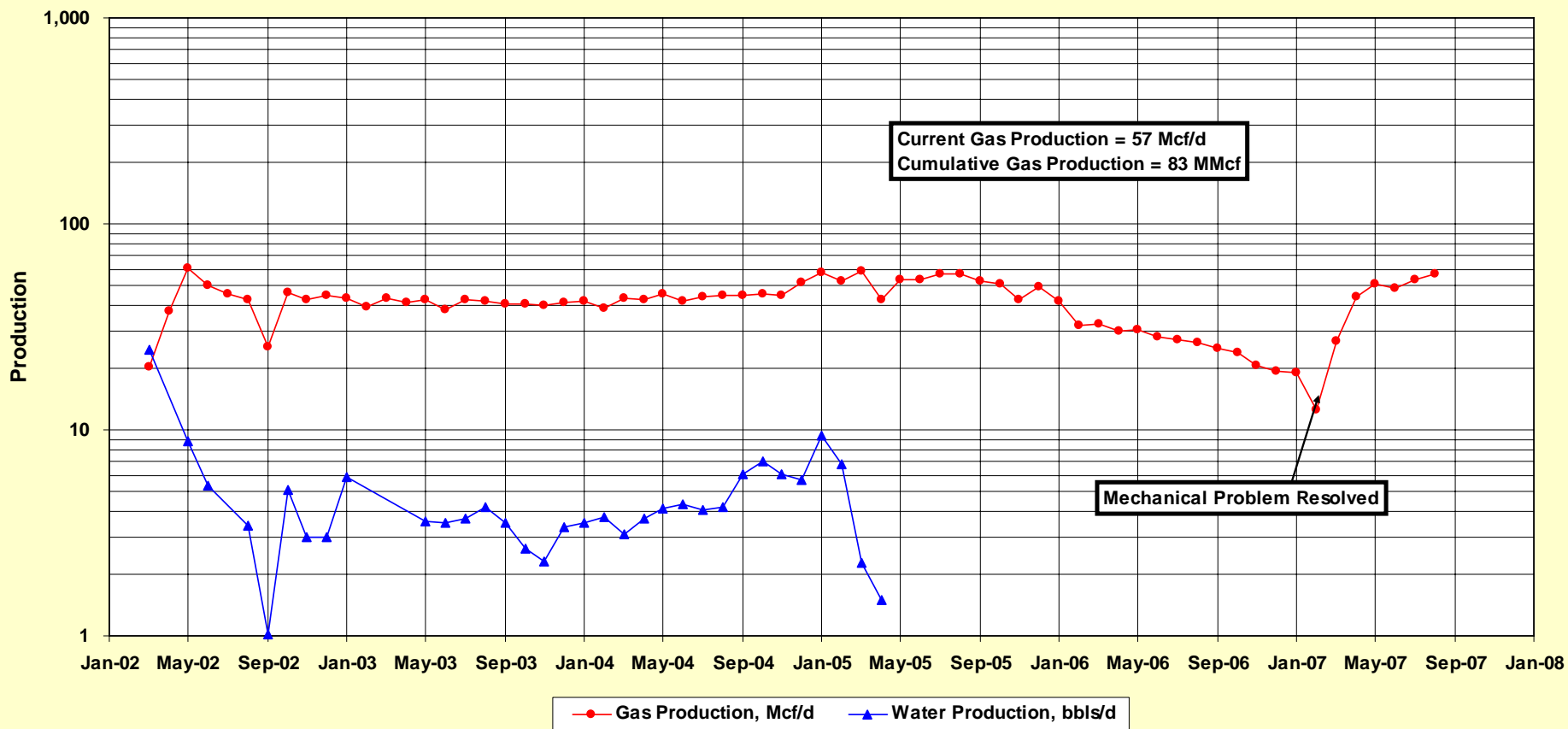


Potential Core Hole Site

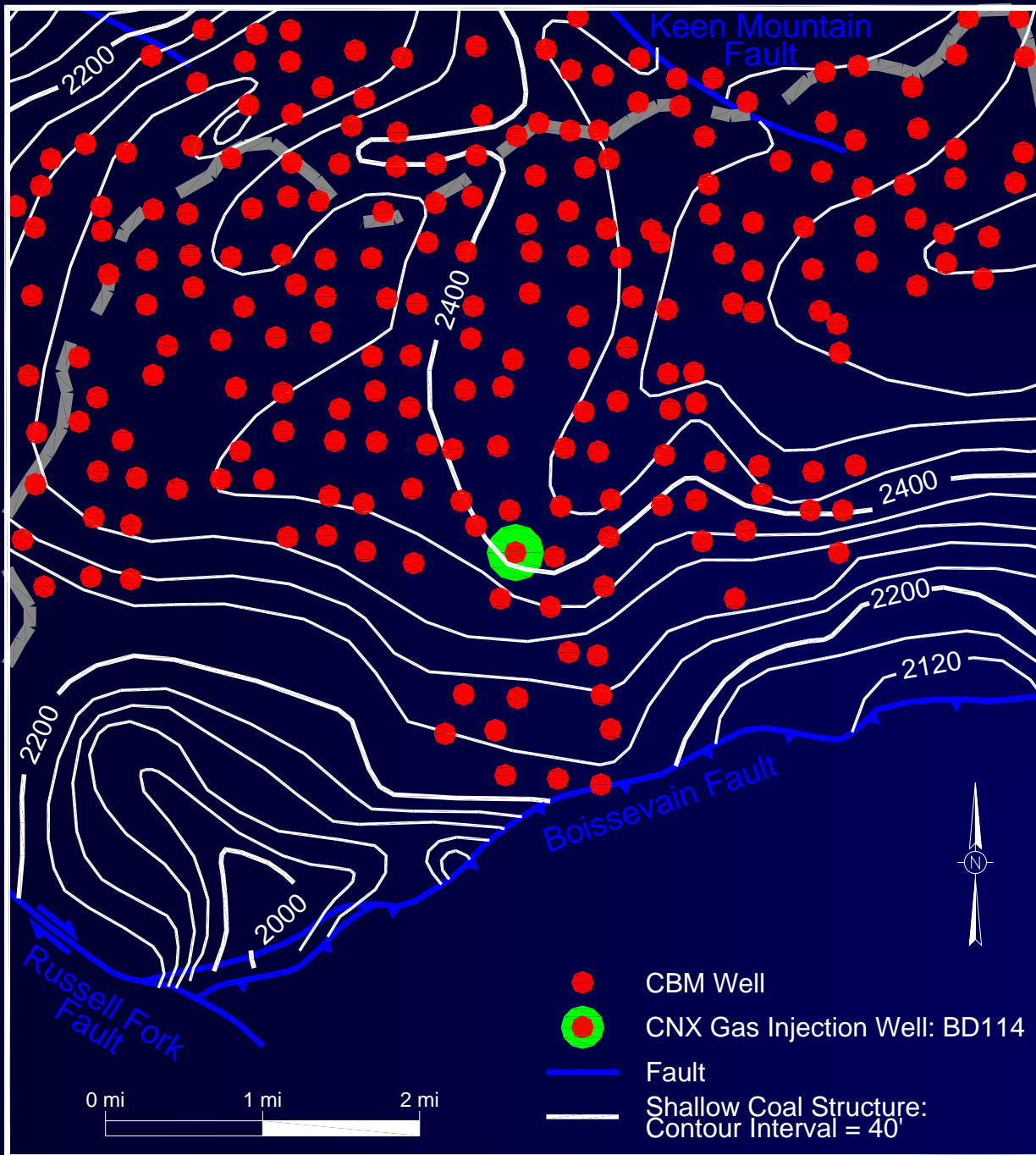


BD-114 Coalbed Methane Production Graph

CNX Gas Pilot Injection Well



Regional Coal Structure Map



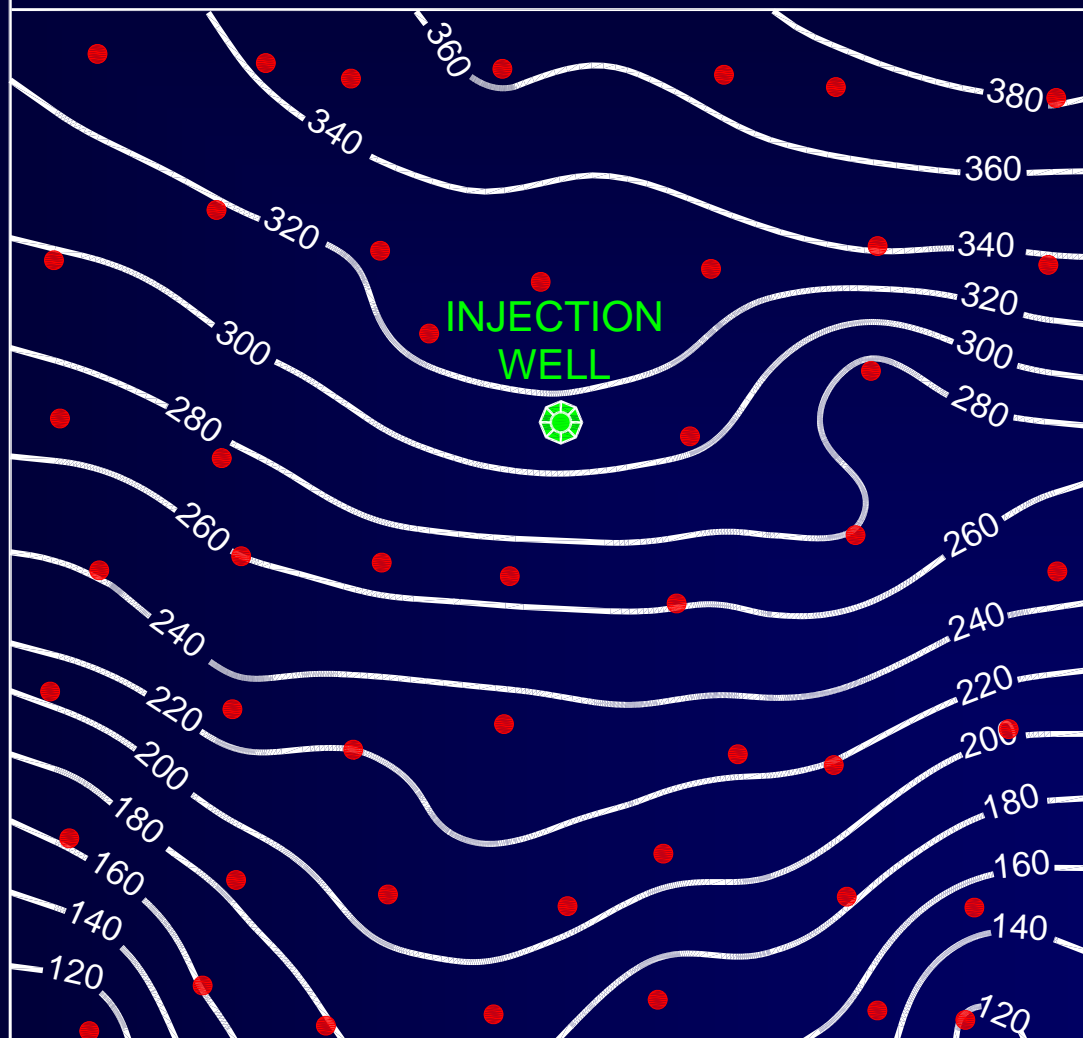
Pocahontas No. 3 Structure

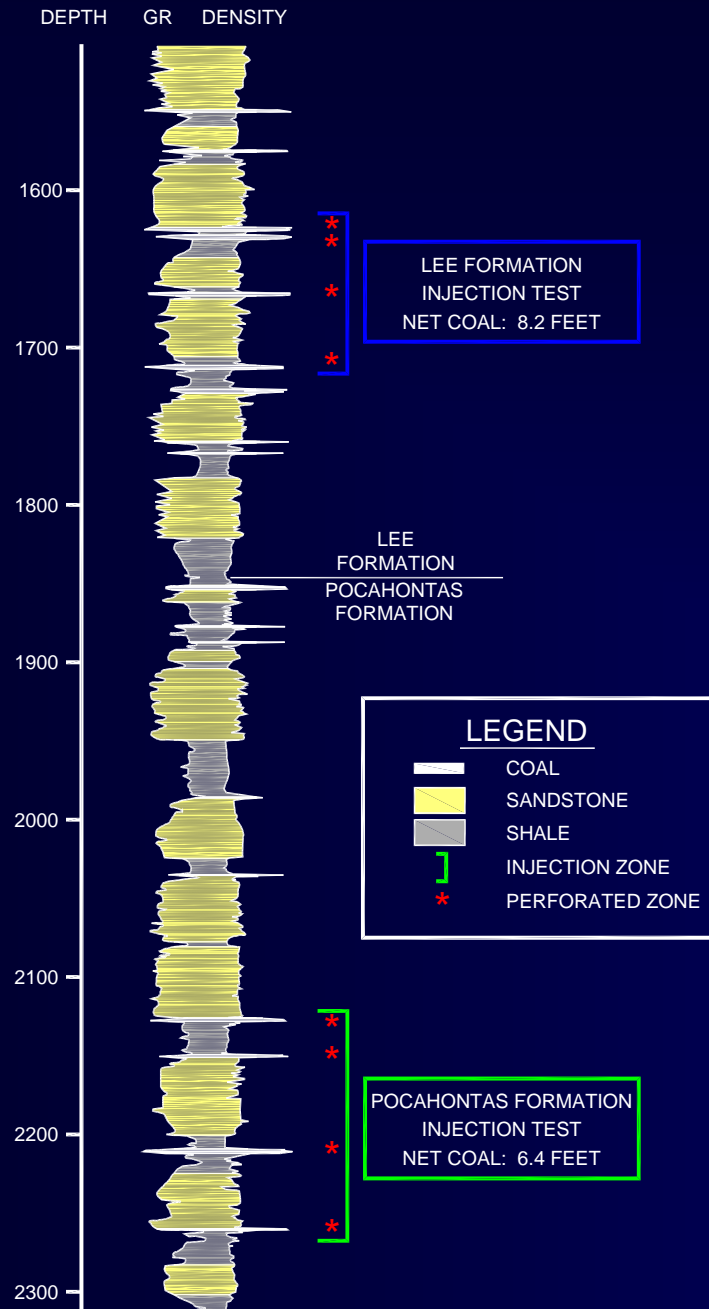


CNX GAS CARBON DIOXIDE INJECTION WELL

260

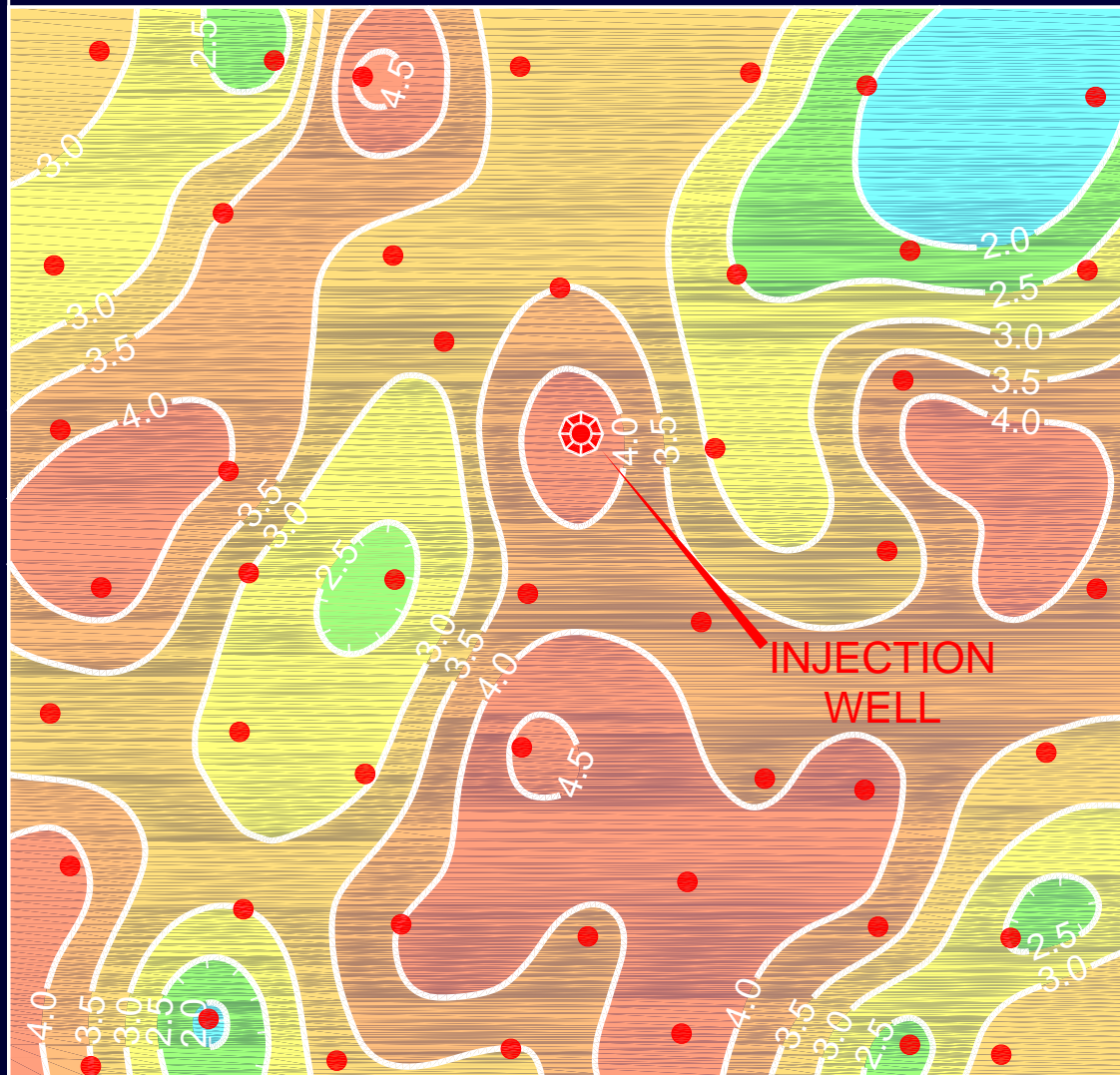
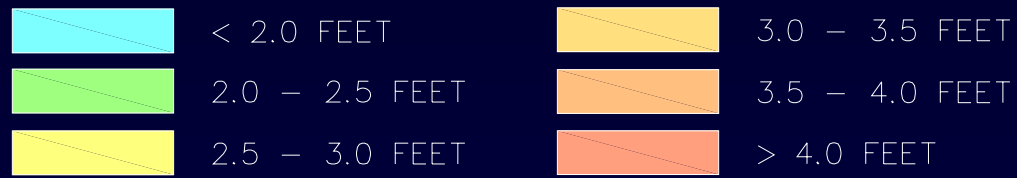
BASE OF POCAHONTAS NO. 3 SEAM STRUCTURE
ELEVATION ISOLINE; CONTOUR INTERVAL = 20 FEET



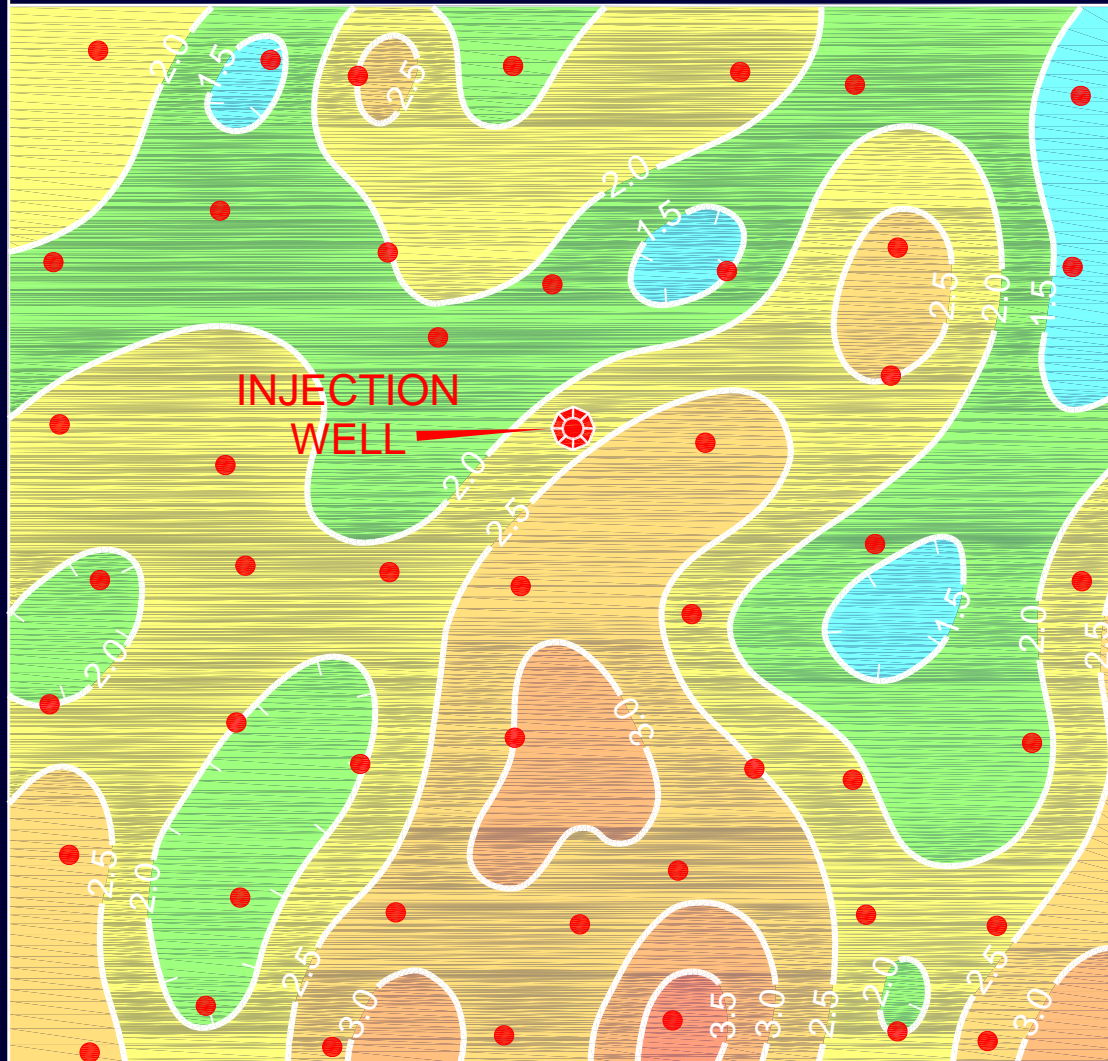
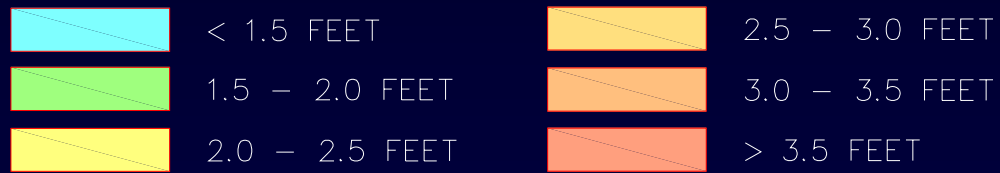


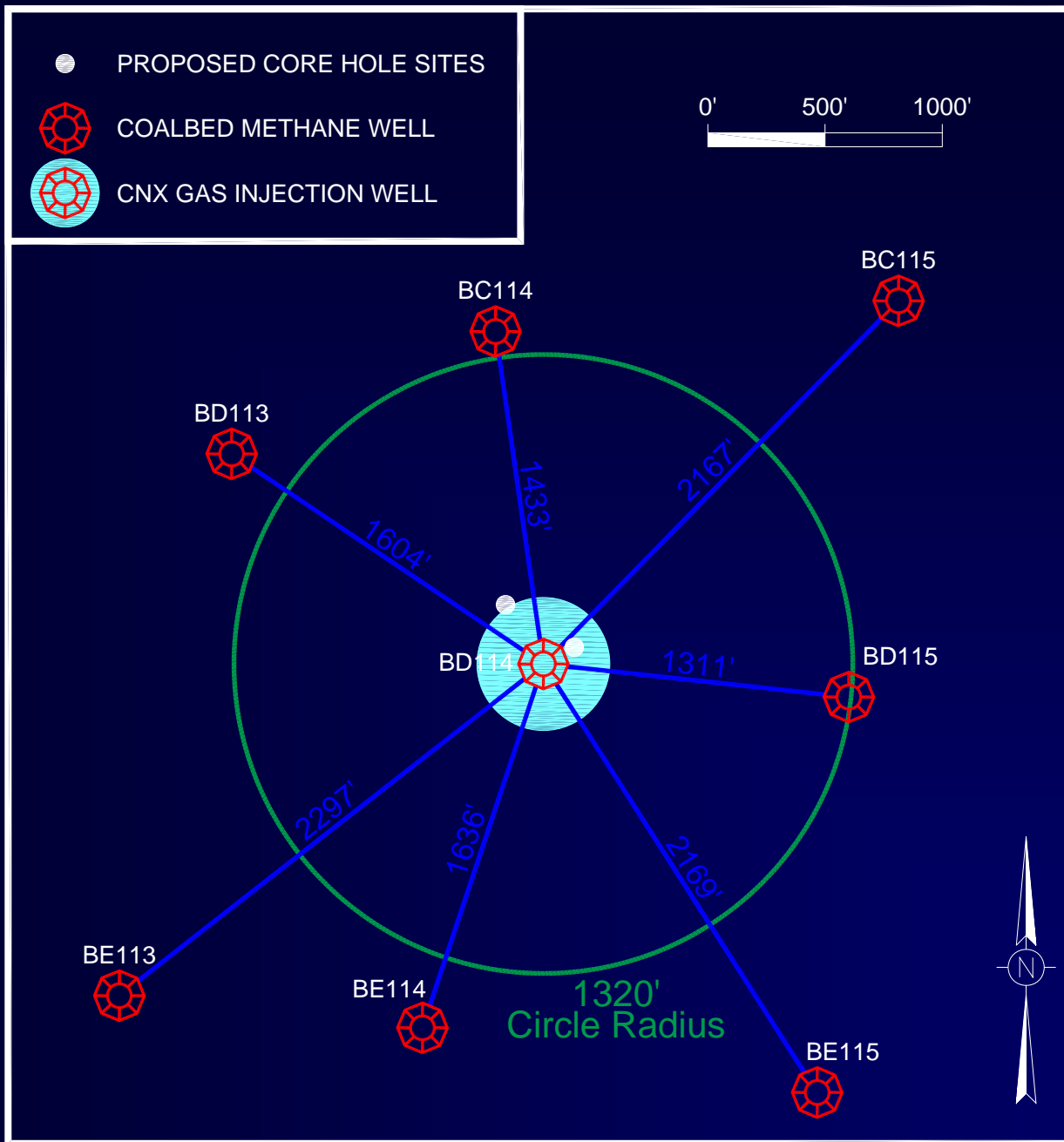
BD-114 Proposed Injection Zones

Lower Horsepen Thickness



Pocahontas No. 3 Thickness





Gas Composition Data

CNX Gas Pilot Area

Well No.	Methane (%)	Nitrogen (%)	CO ² (%)	Oxygen (%)	Ethane (%)	Propane (%)	Btu Content
BC114	97.01	.54	1.87	.01	.557	.015	994
BC115	97.11	.57	2.08	.01	.216	.010	989
BD113	96.58	.50	2.49	.03	.392	.002	987
BD114	96.62	.68	2.33	.02	.351	.002	986
BE114	95.67	1.02	1.80	.02	1.418	.059	998
BE113	95.24	1.02	1.91	.01	1.744	.067	999
BD115	97.01	.83	1.35	.02	.740	.033	998
BE115	96.59	.65	1.89	.00	.822	.019	995
Average	96.48	.73	1.97	.02	.780	.026	993

Core Hole Testing

- ❖ Geophysical logs: gamma ray, caliper, density, neutron, induction, temperature
- ❖ Canister coal cores and desorb methane to determine current gas content
- ❖ Determine methane and carbon dioxide adsorption isotherms
- ❖ Determine permeability of coal cores if competent samples obtained
- ❖ Conduct petrographic analyses of core samples
- ❖ Conduct injection-falloff testing of at least two coal seams for permeability and seam pressure

Measurement, Monitoring and Verification

- ❖ Periodic measurement of soil CO₂ levels near the injection well before, during and after injection testing
- ❖ Periodic composition analyses of gas samples from CBM wells adjacent to the injection well before, during and after injection testing
- ❖ Continuous monitoring of casing pressures and gas and water production rates at adjacent CBM wells before, during and after injection testing
- ❖ Monitor core-hole pressure and gas composition before, during and after injection testing

Test Schedule

❖ Site selection (Complete):	04/06 – 12/06
❖ Soil Gas Monitoring:	01/08 – 09/09
❖ Coring:	03/08 – 05/08
❖ Pressure transient testing:	04/08 – 06/08
❖ Install injection equipment:	07/08 – 08/08
❖ Injection testing:	08/08 – 12/08
❖ Site closure:	06/09 – 09/09